Real Exchange Rate and Asymmetric Shocks in the West African Monetary Zone (WAMZ)

Abstract

This paper examines real effective exchange rate (REER) responses to shocks in exchange rate determinants for the West African Monetary Zone (WAMZ) over the period 1980-2015. The analysis is based on a country-by-country VECM, and oil price, supply and demand shocks are identified using long run restrictions in a structural VAR model. We report significant differences in the response of REER to real oil price, productivity (supply) and demand preference shocks across these economies. In addition, the relative contribution of these shocks to REER movements in the short and long run appears to be different across economies. Our findings suggest that the WAMZ countries are structurally different, and asymmetric shocks with inadequate adjustment mechanisms imply that a monetary union would be costly.

Keywords: Real Effective Exchange Rate, Asymmetric Macroeconomic Shocks, West African Monetary Zone, Currency Union

JEL Classification: E32, E63, F31, F33, F45

1 Introduction

In this paper, we focus on one of the main issues in the debate of the monetary union in WAMZ, the degree of asymmetry in macroeconomic shocks. The West African Monetary Zone (WAMZ)[1] composed of 6 countries, created in 2000 as a second monetary zone in addition to an already existing West African Economic and Monetary Union (WAEMU).[2] The project is aimed to fast track and facilitate the deepening of economic integration in the Economic Community of West African States (ECOWAS). The intention is that WAMZ and WAEMU will be merged to form a single monetary zone in West Africa by 2020 to enable members to exploit both institutional and economic benefits (Debrun et al. 2005; Fielding and Shields 2005; Masson and Pattillo 2005; Masson 2008; Couharde et al. 2013; Ekpo and Udoh 2014).

The main economic cost of a monetary union to WAMZ results from the loss of independent national monetary policy, and the associated nominal exchange rate flexibility, as policy instruments to asymmetric shocks (Buiter 2000; De Grauwe 2000; De Grauwe and Mongelli 2005; Rubio and Comunale 2017). The degree of the cost depends on the debate about the relative merit or effectiveness of nominal exchange rate flexibility as a buffer for adjusting to asymmetric shocks, especially for small open economies (Obstfeld et al. 1996; Kamar and Ben Naceur 2007; Beetsma and Giuliodori 2010; Gervais et al. 2016).[3] On the other hand, the more similar these countries are in terms of structural measures, such as sufficiently flexible labour and capital markets, (Mundell 1961; McKinnon 1963; Kenen 1969); the existence of adequate shock absorbing mechanisms, such as interregional risk-sharing arrangement and automatic fiscal transfer schemes, (Kenen 1969; Mundell 1973; Mélitz and Zumer 1999)[4] and the presence of common shocks with a similar impact, the lower the costs in losing exchange rate stabilizing mechanisms for these economies (Tavlas 1993; Alesina and Barro 2002; Tavlas 2009; Clerc et al. 2011).

[1] WAMZ members: Ghana, The Gambia, Guinea, Liberia, Nigeria and Sierra Leone. The formation of the WAMZ was accompanied with Maastricht type convergence criteria, whose achievements by the six member states are decisive for the prospective monetary union (See Oshikoya 2010).

[2] WAEMU members (former French colonies) are Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo; established in 1994 with a central bank and a single currency known as the CFA franc.

[3] Coulibaly and Gnimassoun (2013) detailed the frequent used of exchange rates by WAMZ countries to response to economic shocks. For instance, during the 2016 falling oil prices, Nigeria floated its fixed currency exchange rate to correct a current account imbalance. The floating of the Nigerian naira after months of policy debates saw the currency immediately plummet by 40% (Lumkile 2016).

[4] Such an adjustment mechanism could be in terms of a unified budget, which automatically redistributes from countries experiencing a strong economy to those suffering from a recession. However, De Grauwe (2000) argues that fiscal transfers are only suited to dealing with temporary demand shocks. When the shock is a permanent one, other adjustment mechanisms will be necessary to deal with the problem (Volz 2010).

In West Africa, the degree of risk-sharing among these countries is quite low (Tapsoba 2011). The political convergence in terms of having a unified budget to facilitate financial transfers from countries experiencing a strong economy to those suffering from a recession is hindered by high government debts, which are typical in developing countries including the ones studied here (Buigut and Valev 2005; Houssa 2008). Although data on factor movement in the region is sparse,[5] it is unrealistic to assume that workers will move quickly from one country to another, even if there are no border barriers due to significant costs, such as for migration and retraining (Kenen and Meade 2008). Consequently, the optimal currency area (OCA) literature points to the importance of symmetry in macroeconomic shocks of monetary union candidates. If shocks are symmetric across countries, like a negative demand shock that is common to all WAMZ countries, then a symmetrical policy response in the form of a common monetary and fiscal expansion would be adequate. However, if shocks are highly idiosyncratic, a common monetary policy will be inappropriate (Bayoumi and Eichengreen 1992; Buiter 1997; Pisani-Ferry 2013). This is the proposition that because of divergences in economic structure (sectoral or industrial composition of production, financial structure, demand, labour market institutions etc.), the monetary transmission mechanism differs among countries. Consequently, a common monetary policy will impact asymmetrically on different countries and sectors (Buiter 2000).

A relatively few empirical studies have used the dynamics of various macroeconomic variables to help assess asymmetry of WAMZ economies and have produced inconclusive results. For instance, (Alagidede et al. 2008; Tsangarides and Qureshi 2008; Asongu 2014; Harvey and Cushing 2015) have revealed the existence of high levels of macroeconomic heterogeneity due to the diverse economic structures of the West African countries, especially those belonging to the WAMZ. Others like Debrun et al. 2005; Coulibaly and Gnimassoun 2013 have reported evidence of macroeconomic convergence regarding competitiveness since the establishment of WAMZ convergence criteria in 2001. This paper provides a contemporary examination of the degree of asymmetry by assessing the behaviour of the real effective exchange rates (REER) across WAMZ countries. The dynamics of REER can have considerable effects on output and prices; providing evidence on REER behaviour among prospective monetary union candidates would suggest the potential costs of sacrificing

[5] Adepoju (2005) documents movement of a significant amount of labour from Ghana to Nigeria during the 1970s oil price boom. Intraregional movements of people within the group has been made easy with the introduction of ECOWAS common passport since 2000.

exchange rate flexibility. A stable and coordinated REER between these countries would suggest that shocks demanding exchange rate adjustment are small, and, consequently, that the cost of giving up nominal exchange rate flexibility would be small. Conversely, large divergent REER can generate competitiveness differentials among candidates, and would indicate the importance of exchange rate flexibility (Edwards 1988b; Von Hagen and Neumann 1994; De Grauwe 1996; Balázs and Amina 2003; Coudert and Couharde 2003; Obstfeld and Rogoff 2009; Lane 2012; Dumrongrittikul and Anderson 2016).

Several approaches have improved our understanding of the link between exchange rates and macroeconomic fundamentals such as; productivity, terms of trade, trade liberalization, government consumption, oil price, and interest rates. (Edwards 1988b; MacDonald 1998; Égert et al. 2006; Dufrénot et al. 2008; Tsen 2011; Chowdhury 2012; Kia 2013; Chen et al. 2017). However, the relative significance of shocks to these fundamentals and the mechanisms through which they affect REER in WAMZ has not been extensively examined. Unlike previous literature, we focus on fundamental shocks to REER, since the REER is likely to move in response to unexpected rather than to expected changes in macroeconomic variables (Alexius and Post 2008; Kizys and Pierdzioch 2009; Dumrongrittikul and Anderson 2016). We therefore identify three shocks of interest from exchange rate determinants using a structural autoregressive model (SVAR) and assess how REER of WAMZ countries respond to the shocks. Notably, the increasingly large dependence of these countries on the export of primary commodities points to the growing importance of both external (such as oil price; terms of trade) and domestic (productivity; demand) shocks to the REER (Obstfeld and Rogoff 2005; Chen and Chen 2007; Obstfeld and Rogoff 2009; Chowdhury 2012; Dumrongrittikul and Anderson 2016). Therefore, the relative role of common external shock on REERs is taken as the key indicator to characterise macroeconomic asymmetry across the countries. By asymmetry, we understand not only the prevalence of country-specific shocks that cause REER fluctuations, but also a different response to common external shocks.

The paper contributes to the extant empirical literature through a number of ways: first, we investigate the long-run and short-run relationships between the REER and its determinants using a country-by-country Vector Error Correction Model (VECM) over the period 1980-2015. Second, we estimate and assess the pattern of REER misalignments using the permanent components of fundamentals as in

the Behavioural Equilibrium Exchange Rate (BEER) procedure. Third, we impose long-run restrictions in a three-vector autoregressive (VAR) model to identify economically meaningful structural shocks, i.e. oil price, productivity (supply) and demand preference- to REER determinants over the period 1980-2015. We consider impulse response and variance decomposition in order to characterise asymmetries in terms of the sign, magnitude, persistence and relative contribution of the disturbances across these countries. Our broad aim is to provide an empirical analysis that can inform policy debates on whether WAMZ economies have attained adequate macroeconomic symmetry for a common monetary policy to suffice.

The rest of the paper is organised as follows; Section 2 presents the data description and sources. Section 3 provides the empirical methodology and results, while Section 4 offers some concluding remarks and policy recommendations.

2 Data Description

The study employs annual data for five WAMZ member states (Ghana, The Gambia, Nigeria, Sierra Leone, and Guinea)[6] over the period 1980-2015. The dependent variable, the REER, is calculated using a trade-weighted index of bilateral exchange rates, adjusted by consumer prices (see Table A1 in the appendix). The nominal effective exchange rate is defined as the price of the domestic currency in terms of the trading-partner currency. The REER and other relevant variables are indexed to 100 in 2000 (WAMZ formation year), and an increase in the index of the REER implies a real appreciation of the domestic currency relative to the basket of currencies of the respective trading partners, whereas a decline implies a real depreciation of the domestic currency. We employ real effective rates instead of bilateral exchange rates because the WAMZ members' foreign exchange transactions are conducted in a global context with the involvement of more trading partner countries in different proportions.

The domestic fundamental determinants are: The relative productivity differential[7] ***prod,*** (proxy to capture the Balassa-Samuelson effect). This variable is constructed from real GDP per capita in PPP[8] for each WAMZ country relative to the top 5 main trading partners using the same weights as for the

[6] The country coverage and the sample period are determined by data availability; hence, the reason for omitting Liberia.
[7] Clark and MacDonald (1999) used the ratio of the domestic consumer price index (CPI) to the wholesale price index (WPI) relative to the equivalent foreign (trade weighted) ratio to capture the Balassa-Samuelson effect. This ratio is designed to proxy the ratio of traded to non-traded price. However, data for WPI/PPI is not available for these countries.
[8] Real per capita GDP is used instead of real per capita GDP in PPP for countries where the latter is unavailable.

calculation of the REER series. The effect of fiscal policy is captured using the proxy variable ***gov*** which is the total government consumption as a percent of GDP. A proxy accounting for trade controls or trade openness is the variable ***open*****,** constructed as the total trade (sum of exports and imports) as a percentage of GDP. Finally, we use the annual interest rate in percent of nominal long-term bonds[9] (10 years for most countries) minus the percentage change in the CPI index from the previous year relative to its effective foreign equivalent, ***rirr***. The external fundamental determinants are: Real oil prices, ***oil*** and relative terms of trade ***tot. oil*** is the US dollar prices of oil converted to the domestic currency and then deflated by the domestic consumer price index (CPI). ***tot*** is constructed as the ratio of domestic export unit value to import unit value as a proportion of the equivalent effective foreign ratio. All the variables are expressed in natural logarithms except ***rirr*** because of some negative observations. The data are gathered from the International Financial Statistics (IFS), World Economic Outlook (WEO) and Direction of Trade Statistics (DOTs), compiled by the International Monetary Fund (IMF), the World Development Indicators (WDI) database of the World Bank, and OECD database. All the series used in this study are derived either directly or by computations using these datasets.

The expected long-term signs of all the explanatory variables on the REER **(q_t)** consistent with theoretical priors (See Obstfeld et al. 1996; Clark and MacDonald 1998; Clark and MacDonald 1999; Hinkle and Montiel 1999; Chen and Chen 2007: for extensive theoretical discussions) are summarised by (1):

$$q_t = f(pro^{+},\ tot^{+/-},\ oil^{+/-},\ open^{-},\ gov^{+/-}, rirr^{+}) \qquad 1$$

Where +/- represents real appreciation and real depreciation of domestic currencies, respectively.

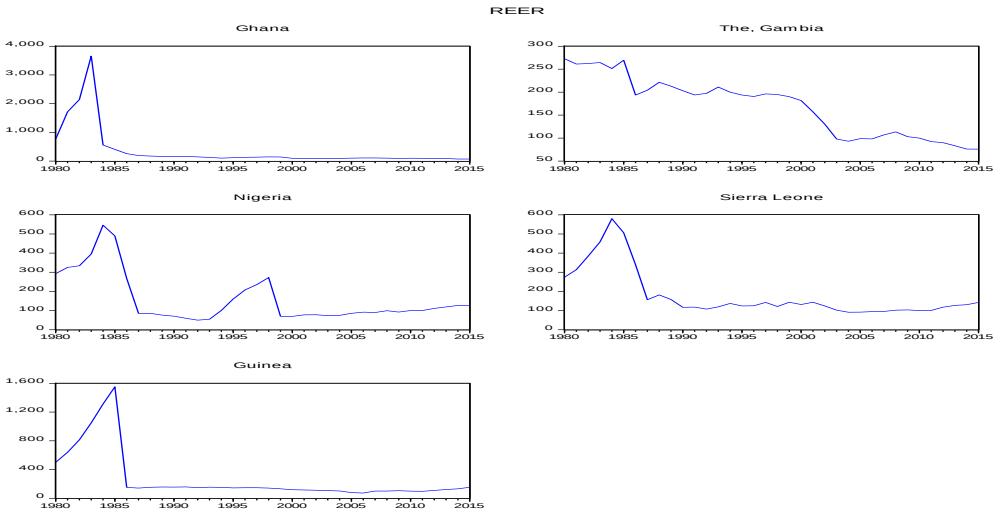
2.1 Real effective exchange rate (REER)

The REERs plot in Figure 1 shows considerable variation in behaviour across the five countries and time, reflecting the changing country-specific exchange rate policies. It is evident from the graph that before 1985, almost all WAMZ countries REERs consistently appreciated on average, except the Gambia where the REER continuously depreciated over the sample period. Afterward, a sharp depreciation is observed in the rest of the countries REERs between 1983-1986, with the break reflecting the structural economic reforms, that the countries undertook in the 1980s (Alagidede et al.

[9] Data is not available for most WAMZ countries, therefore WDI construction is used, i.e., real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.

2008). For instance, in Ghana, the introduction of the Economic Recovery Programme (ERP) in 1983 brought about a dramatic devaluation of the effective exchange rate after maintaining an overvalued exchange rate for most of the 1970s (Fosu 2001). The cedi was floated by the monetary authorities with the onset of ERP 1983 under the guidance of the World Bank and the IMF (Boamah 2009), while in Nigeria the naira was floated in 1986 following the introduction of structural adjustment policies. Guinea's currency was devalued in 1986. Implicit in the recommendation of a devaluation is the view that the real exchange rate is out of equilibrium; hence an effort to correct the serious overvaluation of the currency and to bring into line official and parallel market prices (WorldBank 1986).

Figure 1 Real Effective Exchange Rate (2000=100)



We test each variable for the presence of a unit root by using the augmented dickey fuller (ADF) and Phillips-Perron (PP) unit root tests. The results from the ADF and PP tests show that in all cases the tests fail to reject the null hypothesis that the series are integrated of order 1 at the 5% significance level, except interest rate differentials (***rir)***, which is $I(0)$ in all the five countries (See Table A2. in the Appendix). In addition, we conducted a stationarity test in the presence of structural break on the REER. According to Perron (1989), if there is a break in the deterministic trend, then conventional unit root tests may produce a misleading and biased conclusion. Hence, we employ the Perron (1997) unit root test with structural break to examine only the REER for the sake of brevity. Despite the structural breaks, the REER of WAMZ countries remain $I(1)$, except Sierra Leone which is $I(0)$ (see Table A3. in the Appendix). Interestingly, most of the breakpoints were in the 1980s, which is consistent with the

major economic reforms discussed above. Therefore, we have enough evidence to validate the use of cointegration tests.

3 Empirical Methodology and Results

The empirical approach of this research is twofold. First, we examine the long-run and the short-run relationships between the REER and the selected fundamental variables across WAMZ countries over the period 1980-2015. We apply individual country VECM, and further derive the equilibrium REER and misalignments for these countries. Second, we measure the asymmetry of macroeconomic shocks across these countries using a structural vector-autoregressive (SVAR) model. The aim is to identify and assess the responses of REER to the shocks of interest; oil price, productivity (supply) and demand preference. Thus, whether these shocks to REER determinants differ across WAMZ countries to help inform policy decision on common monetary policy for the group.

3.1 Cointegration - REERs comovements

Having determined that all the series involved in our analysis (lreer, lpro, ltot, loil, lopen, lgov) are $I(1)$, we proceed to the cointegration analyses of the variables (Engle and Granger 1987; Hsiao 2014). The paper employs a vector error correction model (VECM)[10] to analyse the long-run and the short-run relationships between the REER and the selected macroeconomic fundamentals. We first estimate the long-run relationship between the REER and the selected fundamentals, and then we determine and interpret the REER's adjustment factor.

We specify a simple VECM between the REER and the fundamentals that restrict the long-run behaviour of the endogenous variables to converge to their cointegrating relationship while allowing for short-run adjustment dynamics (Gervais et al. 2016) in equation 2:

$$\Delta \boldsymbol{y_{it}} = \boldsymbol{\alpha \beta' y_{it-1}} + \boldsymbol{\Gamma_1 \Delta y_{it-1}} + \cdots + \boldsymbol{\Gamma_{p-1} \Delta y_{it-p+1}} + \boldsymbol{\Phi D_{it}} + \boldsymbol{\mu_{it}} \qquad 2$$

Where, $y_t = (lreer,\ lpro,\ tlot,\ loil,\ lopen,\ lgov)$ is $(6x1)$ vector of variables, and $\Gamma_i = -(I - A_1 - \cdots - A_i)\ i = 1,2,3, \ldots\ldots, p-1$, β' represents the long-run equilibrium relationships between the REER

[10] Further discussions related to VECM applications are provided by (Johansen 1995; Lütkepohl and Krätzig 2004; Enders 2008).

and the fundamentals, and the $\boldsymbol{\alpha}$ matrix, measure the speed of adjustment of the REER. To evaluate REER comovement in WAMZ, we expect a significant and negative $\boldsymbol{\alpha}$ coefficient for all the participating countries. This would indicate that the REER tends to stabilise itself in the event of exogenous shocks. $\boldsymbol{D_t}$ is a vector of deterministic components, such as constant, seasonal dummies and intervention dummies.

We first estimate the $\boldsymbol{\beta'}$ using the conventional Johansen cointegration tests for the time series on a country-by-country basis, by assuming that all variables are endogenous in the system.[11] Testing for cointegration using the Johansen method requires testing for the reduced rank or determining the number of cointegrating vectors in the system (Johansen 1988; Johansen 1991; Johansen 1995). Therefore, both the Johansen's trace and max-eigenvalue test statistics are used to assess whether the variables are cointegrated and, if so, the number of cointegrating relationships. We select an optimal lag of 1 for all the countries; lag selection was based on the lowest Schwarz information criterion (SIC) in conjunction with the observation of Gaussian errors. Although one lag is very restrictive even for annual data (Baffes et al. 1999), longer lag lengths leave us with very few degrees of freedom.[12] Furthermore, the (Johansen 1992) "*Pantula principle"*[13] is applied in identifying the deterministic components for our estimation since the test can be very sensitive to the optimal lag length and deterministic trend components (Harris 1995).

Table 1 reports the trace and maximum eigenvalue test of cointegration for the five countries. Based on the likelihood ratio statistics, we strongly reject the null hypothesis of no cointegration for all countries at the 5% significance level. Therefore, we conclude the existence of a long-run relationship between the REER and fundamental determinants. A detailed analysis of the cointegrating vectors is provided in the next section to assess the co-movement or behaviour of the REER across WAMZ countries. The major implication derived from both the trace and maximum eigenvalue tests is the evidence of one cointegrating relation among the variables in the system of these economies. The

[11] Johansen (1995) argue that all variables in the system must have the same order of integration. Hence, we did not include the I(0) variable, **irr** in the cointegrating space. Furthermore, The Johansen approach does not require the choice of a dependent variable and hence addresses the endogeneity problem of variables (MacDonald 1998).

[12] Diagnostics tests were conducted to ensure that the selected lag lengths ensure the VAR and the associated VECM model residual do not suffer from autocorrelation, non-normality, etc.

[13] This involves estimating three alternative models (i.e. no intercept or trend, intercept and no trend, intercept and trend) and moving from the most restrictive to the least restrictive model. The trace test statistic or the maximum eigenvalue test statistic is compared to the critical value in each case, and the most appropriate model is deemed to be the one where the null hypothesis is not rejected for the first time (Hatemi-J 2002).

results support the theory of generalized purchasing-power-parity (G-PPP)[14] in WAMZ countries REERs (Enders and Hum 1994).

Table 1 Johansen Cointegration Statistics

	Ghana		**The Gambia**		**Nigeria**		**Sierra Leone**		**Guinea**	
	λ_{trace}	λ_{max}	λ_{trace}	λ_{max}	λ_{trace}	λ_{max}	λ_{trace}	λ_{max}	λ_{trace}	λ_{max}
Lags	**1**		**1**		**1**		**1**		**1**	
$r = 0$	107.17*	41.52*	103.07*	40.53*	119.02*	46.27*	150.96*	63.94*	82.26*	40.52*
$r = 1$	65.65	28.41	62.53	28.47	72.75	25.67	87.01	28.30	41.74	20.82
$r = 2$	37.24	19.29	34.06	20.01	47.07	19.27	58.70	24.47	20.92	10.49
No. of CE	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Note: *, ** denote the rejection of the null hypothesis at the 5% and 10% significance level respectively. We test the existence of cointegration in the vector conformed by (REER, TOT, PROD, OIL, OPEN, GOV) using the trace test developed by Johansen (1991;1995).

It is important to note that our initial Johansen cointegration tests with all the fundamentals in the system recorded more than one cointegrating relationship in Nigeria, Sierra Leone, and Guinea.[15] It is well established in the literature that the existence of multiple cointegrating vectors complicates the interpretation of the equilibrium relationship between the REER and its fundamental determinants and presents the problem of identification (Johansen 1992; Iimi 2006). Therefore, we addressed the above problem by omitting the $I(0)$ variable, **rir**, from the cointegrating vector, while yielding just one cointegrating relationship.[16]

3.1.1 Interpreting the cointegrating vector

The results of the normalised cointegrating vectors for the five sample countries are reported in Table 2. Overall, the coefficients of the estimated variables are statistically significant on at least the 5% level of significance. Also, the coefficients of the fundamentals- productivity differential, terms of trade, openness, government consumption, and real oil price- capture their long-run impact on the REER, but the impacts are different across economies.

[14] The G-PPP theory suggests that the fundamental economic variables determining RER are nonstationary and if the fundamentals are sufficiently integrated, as in a currency area, the real rates will share common trend.
[15] (Cheung and Lai 1993; Baffes et al. 1999) argue that the likelihood ratio test of cointegration is known to be sensitive to small-sample bias, making the properties of the trace test different from its asymptotic properties sometimes.
[16] Harris (1995) argues that for every stationary variable included in the multivariate model, the number of cointegration equations will increase correspondingly.

1. An increase in the relative productivity differential is associated with a real appreciation (confirming the Balassa–Samuelson effect) in Guinea and Sierra Leone. However, the estimated coefficient associated with productivity differential has an unexpected sign- negative- in the remaining three countries, suggesting that increase productivity differentials are associated with real depreciation. A plausible reason is that an increase in productivity differentials might be generated by productivity growth in the non-traded sector of these economies, which in theory has unclear effects on the prices of non-traded goods.[17]
2. An improvement in terms of trade is associated with an appreciation of the REER in all the countries, except in Nigeria. This is in line with Chudik and Mongardini (2007) argument that since the prices of the commodities exported by developing countries (here WAMZ members) are determined in the world market, an improvement in the terms of trade will positively affect the trade balance, and subsequently lead to REER appreciation.
3. An increase in the degree of openness is associated with a real depreciation in all countries, except in Guinea where the variable is omitted in the model due to data unavailability. This suggests that increasing trade liberalization arrangements among these countries is associated with a real depreciation of the REERs; consistent with the traditional view. Thus, an increase in the degree of openness is associated with decreasing trade barriers, imports rise more than exports, and the deterioration in the trade balance results in REER depreciation (Égert et al. 2006). This could be the result of the high degree of trade liberalization arrangements that the countries have achieved through ECOWAS common trade policies since 1975.
4. An expansionary government consumption on non-tradable is associated with a real appreciation in The Gambia, Guinea, Nigeria, and Sierra Leone while the contrary, a real depreciation is observed in Ghana. The conflicting sign reported is consistent with the literature which argues that the prediction depends on the allocation of government consumption expenditure to tradable and non-tadable goods. But for the case that actual data on government expenditure on non-tradable are very limited and are almost non-existent in many developing countries, the actual sign of this proxy can be either positive or negative (Edwards 1988b; Elbadawi 1994; Elbadawi and Soto 2005; Ricci et al. 2013).

[17] See Edwards (1988b) for further explanation

5. Finally, an adverse real oil price is associated with real depreciation in Ghana and The Gambia. This is not surprising considering that these countries are oil importing countries where world oil prices are denominated in foreign currencies. Hence, an increase in the real oil price will lead to a decrease in terms of trade and subsequently depreciate REER. On the other hand, an increase in real oil price is associated with a real appreciation in Nigeria, Sierra Leone, and Guinea. The positive estimated coefficient for real oil price in Nigeria is expected, being a major oil exporting economy, whereas the real oil price is found to have the unexpected positive sign for Sierra Leone, and Guinea.

In a nutshell, the following observations can be made based on the above cointegrating results: First, overall, productivity differential, terms of trade, openness, government consumption, and the real oil price are found to be important in the REER determination in the long run. However, the results show cross-country variations in the impacts of those variables on the REER, suggesting lack of macroeconomic policy coordination. However, Beirne (2010) argues that given differing business cycle, trade, and consumption patterns across developing countries, it is not feasible that all the coefficients will move in the same direction. Nonetheless, this reiterates the need for further policy coordination within the group. Second, it is worth mentioning that although the behavioural equilibrium exchange rate (BEER) methodology defines the existence of a long-run relationship between the REER and its determinants, it is not always possible that the REER may be in equilibrium at every point in the long run due to possible imperfections, rigidities or regulations; however, equilibrium may be achieved gradually in the long-run. For that reason, the short-run adjustment factor is estimated in Section 3.2 to complement the long-run equilibrium model in the empirical analysis.

Table 2 Results of Cointegration Estimation

Ghana	$lnreer_t = -7.1022lnpro + 0.7096tot - 3.4708open - 0.860gov - 3.195oil + 1.0553trend + 28.09$ $[-5.53133]\quad [3.17991]\quad [-10.9678]\quad [-2.42685]\quad [-11.6742]\quad [10.9236]$
The Gambia	$lnreer_t = -2.870pro + 0.065tot - 0.4405open + 0.2784gov - 0.1959oil - 0.0995trend + 17.3978$ $[-6.58084]\quad [4.69451]\quad [-7.26788]\quad [5.66886]\quad [-4.60436]\quad [-5.82748]$
Guinea	$lnreer_t = 0.6195pro + 0.5798tot + 0.353gov + 0.1419oil - 0.0542$ $[2.16213]\quad [4.71414]\quad [5.27115]\quad [5.73973]$
Nigeria	$lnreer_t = -0.8664pro - 0.500tot + 0.7268gov - 1.170open + 1.8717oil - 0.4625trend + 9.7600$ $[-2.10256]\quad [-2.51498]\quad [5.64570]\quad [-7.80483]\quad [7.05473]\quad [-7.32229]$
Sierra Leone	$lnreer_t = 7.753pro + 2.3794tot + 2.3425gov - 2.1678open + 0.6174oil - 12.9445$

	[9.83603] [6.81112] [4.60776] [−8.71549] [7.79347]

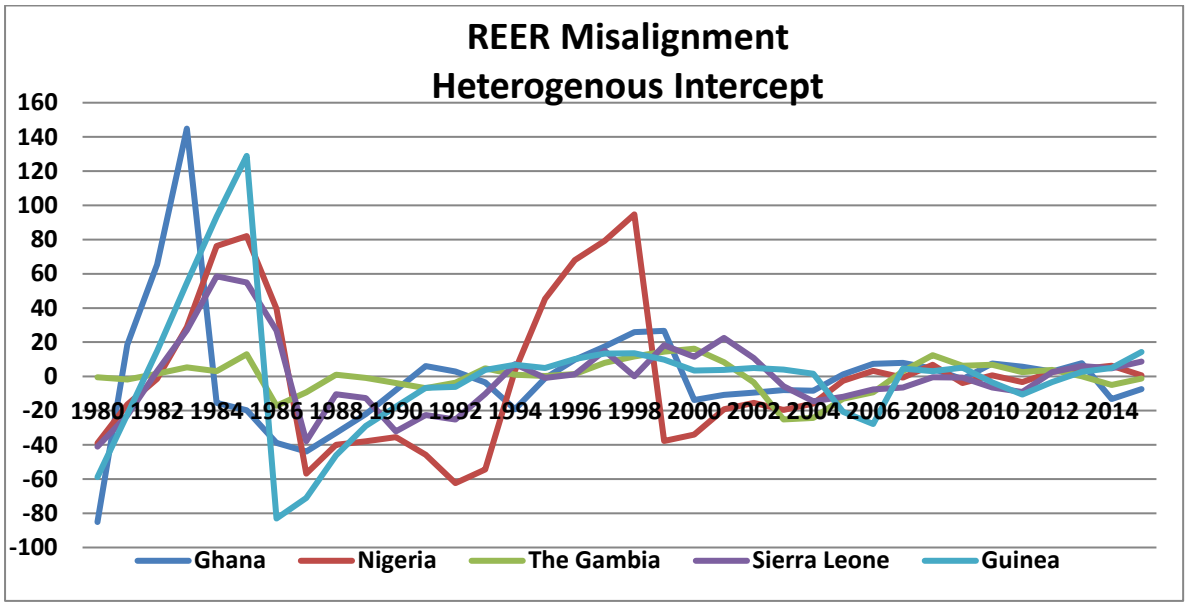
Note: [ ] t-statistics

Figure 2 plots the observed REER misalignments of WAMZ countries. Following (Clark and MacDonald 1998), REER misalignment is defined as the deviation of the actual REER ($\boldsymbol{q_t}$) from the equilibrium ($\tilde{\boldsymbol{q}}_{\boldsymbol{t}}$) REER; where positive values indicate REER undervaluation and negative ones REER over-valuation. A visual inspection indicates signs of possible substantial divergences of the REERs from their equilibrium path. This suggests that the REERs for most countries follow paths that are out of line with fundamentals- misaligned. The indication is that changes in the fundamentals may have differentiated impacts on the REER across the countries or perhaps indicating problems of exchange rate management. Figure 2 shows that before 2000- the base year- there is a clear episode of real overvaluation and undervaluation in all the countries' REERs. Nevertheless, considering the influence of different historical, economic and political traditions such as the major exchange rate policy changes undertaken by these countries as part of the economic reforms supervised by the IMF and World Bank in the 1980s and political instability, the degree of misalignments could be argued 'natural' for the region. For instance, the sharp deviation between 1993-98 in Nigeria is consistent with the political instability the country underwent during Abacha's military regime. Moreover, Nigeria remained an outlier for the most part of the period before 2000, probably due to its influence as the biggest economy in GDP and population amongst the group.

Interestingly, the relative misalignments appear to have declined since 2007 as the individual member's REER trend towards the common equilibrium path. This somewhat concurs with Coulibaly and Gnimassoun (2013) report that the dispersion of misalignments in the WAMZ area has relatively diminished since 2000, reflecting a convergence between competitiveness levels of its member countries. In other words, these countries have not gone through any excessive real devaluation since 2007. Perhaps, we can argue that they rely more on interest rate tools for macroeconomic adjustment than instead of nominal exchange rate adjustments. Notwithstanding, more attempts are required to eliminate total misalignments amongst members and bring the REER in all countries closer to equilibrium. In the context of sound macroeconomic policies and stable external factors, REER could follow paths that are in line with fundamentals (Edwards 1988a; Isard and Faruqee 1998; Gulde and Tsangarides 2008; Chowdhury 2012). Therefore, as indicated in previous studies (Debrun et al. 2005;

Fielding and Shields 2005; Alagidede et al. 2008) a monetary union in WAMZ inevitably depends on how well the authorities achieve macroeconomic integration before upscaling to a full monetary union.

Figure 2 REER Misalignment



Source: Authors (2018)

3.2 Short-run adjustment factor

We turn next to the short-run adjustment factors or speed of adjustment of the REERs and the fundamentals. Though we base most of our interpretation of the impulse response in the subsequent section, we comment on some of the short-run adjustment coefficient estimates first. Our estimated equation, equation 2 suggests that when the estimated $\boldsymbol{\alpha}$ coefficient is negative and significant, then deviations from the cointegrating relationship[18] can be corrected through the adjustment of the REER. Therefore, we further explore whether the REER in WAMZ countries respond significantly to past deviations.

To ensure confidence in the VECM estimation, we examine whether the variables are weakly exogenous in the system since some of the variables in the cointegrating matrix are in differentials (differences between domestic and foreign variables) (Harris 1995; Hendry 1995). We conduct formal tests that the relative terms of trade, productivity differentials and real oil price are weakly exogenous. The null hypothesis of zero restrictions weakly exogenous cannot be rejected in most cases for these

[18] The Engle and Granger (1987) representation theorem asserts that the existence of an error-correction representation depends on the existence of cointegration.

variables. See Table A4 in the Appendix. Also, we can assume a priori that relative terms of trade and world oil price as weakly exogenous. The reason is that these countries are small open economies and can be accepted as price-takers in international trade, i.e., they have no or little influence on the price of their exports or imports (Harris 1995; Opoku-Afari et al. 2004). In addition, the study conducted the VEC Residual Serial Correlation LM Tests; VEC Residual Normality Tests; VEC Residual Heteroskedasticity Tests; inverse AR root test[19] to ensure the VECM is stable and do not suffer from autocorrelation, non-normality, heteroscedasticity, and non-stationarity. The inverse AR root tests for all the countries suggest a stable (stationary) VECM. See Table A5 in the Appendix.

The estimated short-run adjustment coefficients and the associated t-ratios are presented in Table 3. The adjustment coefficients shed light on the dynamics of the adjustment process towards equilibrium. In the event of any deviation from the long-run equilibrium, these variables jointly respond and adjust the system back to equilibrium. The REER adjustment factor D(lreer), is negative and statistically significant, as expected from theory for all the countries, except The Gambia and Sierra Leone. In addition, a similar speed of adjustment across these countries would imply that the countries REER responds symmetrically to shocks. However, the speed of adjustment D(lreer) slightly varies across the countries, with coefficients ranging from 0.94 in Guinea, 0.81 in Nigeria, to 0.53 in Ghana. For instance, an adjustment coefficient of 0.94 suggests that about 94% of any misalignment between the actual and equilibrium REER is corrected within a year. This show less persistent adjustment dynamics in Guinea's REER relative to the remaining countries. We deduce that the other countries with low REER adjustment speed, e.g., Ghana, could be due to limited nominal exchange rate flexibility. The above adjustment factors corresponding to a half-life of the REER of 0.7 years for Guinea, 0.9 years for Nigeria, and 1.3 years for Ghana.[20] The adjustment speed for Ghana is comparable to that of Asongu (2014), who finds the half-life of 1 year for the REER, but the remaining countries coefficients were insignificant. On the other hand, the short-run effects of the fundamentals are generally insignificant across the various specifications apart from the real oil price equation in Ghana and Guinea; productivity differentials, openness and government consumption in The Gambia. These variables contribute to REER realignment.

[19] Results available upon request
[20] The implication is that the REER returns to equilibrium within the above listed period if it meanders from its equilibrium path.

Table 3 Estimated adjustment coefficients in VECM

	Ghana	The Gambia	Guinea	Nigeria	Sierra Leone
D(lreer)	**-0.529*** **[-2.040]**	-0.245 [-1.126]	**-0.941*** **[-1.758]**	**-0.807*** **[-3.418]**	-0.003 [-0.043]
D(lpro)	0.029 [2.986]	**-0.256*** **[-2.941]**	0.122 [1.436]	0.0160 [0.300]	0.138 [3.962]
D(ltot)	0.076 [0.474]	3.075 [1.587]	0.590 [1.232]	-0.248 [-1.082]	-0.004 [-0.080]
D(loil)	**-0.318*** **[-2.349]**	1.292 [1.602]	**-2.321*** **[-1.790]**	-0.414 [-1.318]	-0.014 [-0.094]
D(lopen)	-0.002 [-0.040]	**-1.335*** **[-2.932]**	-	-0.201 [-0.797]	-0.029 [-0.214]
D(lgov)	-0.050 [-0.560]	**-1.216*** **[-2.315]**	0.825 [1.257]	-0.278 [-1.170]	0.108 [1.448]
Half-life of deviation from ERER in years	1.3	-	0.7	0.9	-

Notes: *, ** denote the rejection of the null hypothesis at the 5% and 10% significance level respectively. [ ] t-statistics

3.3 Measuring Shock Asymmtry: Shock Identification strategy

Building on the empirical model outlined in Section 2, our interest in this section is to examine the real effective exchange rate (REER) responses to shocks in exchange rate determinants across the West African Monetary Zone (WAMZ) economies; and whether disturbances are distributed symmetrically across the countries. Based on the analysis in section 2, we consider three shocks representing both external and domestics- oil price (common external), supply (productivity) and demand preference shocks- that could be an important driver of REER fluctuations in the area.

In this paper, a persistent change in world oil prices with a persistent effect on WAMZ country's REER would be captured as a common external shock (Forbes et al. 2015). These economies are closely integrated into the wider global economy with their heavy reliance on export of primary commodities; global or external developments affect the economic fortune of these countries. Consequently, the prevalence of external shocks may justify common monetary policy for the countries (Zhao and Kim 2009). A rise in world oil price will worsen the balance of trade position of a net oil-importing country, subsequently lead to a real depreciation of the REER (Zhou 1995; Chen and Chen 2007). An increase in domestic productivity would be captured as a domestic supply shock or productivity shock.

A supply disturbance is identified as a shock such as improvements in technology, that causes productivity shock in traded sectors relative to nontraded sectors. This type of productivity shock is central to the Balassa-Samuelson hypothesis. Productivity shocks in countries with higher productivity in the tradable sector typically result in permanent REER appreciation (Balassa 1964; Samuelson 1964; Edwards 1989). In addition, changes in the REER is referred here as real aggregate demand shocks not related to money, such as preference or fiscal shocks (Rogers 1999; Craighead and Tien 2015). An increase in the real demand shocks such as the propensity to consume would result in higher prices and an appreciating REER in the long run (Alexius and Post 2008). The domestic or country-specific shocks are shocks that only affect a particular WAMZ member economy due to a change in domestic policy or a change in productivity.

To identify asymmetric macroeconomic shocks, we estimate a three-variable VAR in first differences and assume that $X = [\,\Delta(oil_t), \Delta(pro_t), \Delta(reer_t)]$- change in the logarithm of the real oil price (o_t), the logarithm of the productivity differential (p_t) and changes in the logarithm of the real effective exchange rate (r_t)- are related to three uncorrelated structural innovations, $\varepsilon_t = [\,{\varepsilon_t}^o,\ {\varepsilon_t}^s,\ {\varepsilon_t}^d]$. The structural shocks are unobserved. Hence we estimate a reduced form $VAR(p)$ with a lag length (p) chosen such that the residuals approximate white noise by imposing appropriate identifying restrictions on A_0^{-1}. Under the appropriate restrictions, structural shocks can be recovered from the estimated reduced form errors by using the following relationship:

$$\boldsymbol{e_t = A_0^{-1}\varepsilon_t} \qquad \textbf{3}$$

Where e_t denotes the reduced-form errors. To derive three types of structural shocks: oil price $({\varepsilon_t}^o)$, supply $({\varepsilon_t}^s)$ and demand $({\varepsilon_t}^d)$, we need nine constricted conditions for the model including three endogenous variables. The orthogonality of the structural shocks (unit variance $Var(\varepsilon_t) = I$) identifying assumption provides six restrictions to identify matrix A_0^{-1}. The other identifying assumptions are the long-run restrictions, which gives as the following recursive structure of the model:

$$e_t \equiv \begin{bmatrix} \Delta(oil_t) \\ \Delta(pro_t) \\ \Delta(reer_t) \end{bmatrix} = \begin{bmatrix} a_{11i} & 0 & 0 \\ a_{21i} & a_{22i} & 0 \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix} \begin{bmatrix} {\varepsilon_t}^o \\ {\varepsilon_t}^s \\ {\varepsilon_t}^d \end{bmatrix}$$

The lower triangularity of the model can be justified as follows: (1) WAMZ country-specific shocks do not have a contemporaneous effect on the world oil price. This restriction is necessary to identify domestic shocks, and holds for small open economies, such as the countries under investigation. The assumption that small open economies cannot affect the rest of the world is commonly employed in the literature (Zhao and Kim 2009; Carrière-Swallow and Céspedes 2013; Forbes et al. 2015).[21] (2) In the long run, productivity is only affected by supply-side shocks ($\varepsilon_t{}^s$), such as technology shock (Blanchard and Quah 1989), while the real exchange rate can be affected by both supply and demand side factors (Craighead and Tien 2015).

It is worth noting that whereas the three structural innovations may mix various underlying shocks, our focus is on whether commonalities exist in WAMZ country's REER after the three structural shocks and how significant they are proportional to each other.

3.3.1 Impulse response analysis

We compute impulse response functions to determine the behaviour of shocks to the exchange rate fundamentals across WAMZ countries. The same data used in the VECM analysis is used for the impulse responses. We mainly focus on the responses of the real effective exchange rate to three structural innovations- oil price, productivity and demand preference shocks. The prevalence of structural shocks may justify common monetary policy for the group; especially the oil price (external) shock. A shock is considered to be symmetric if the sign, magnitude, and persistence of the responses do not vary significantly across countries, otherwise it is considered as asymmetric (Bayoumi and Eichengreen 1992; Ballabriga et al. 1999). In estimating the three-VAR model, the number of lags is set to one, since the Schwarz Information Criterion (SIC) indicated that all the models had an optimal lag length of either one or two. We chose a uniform lag of one to preserve the symmetry of the specification across countries.

Figure 2 reports the cumulative impulse responses of real exchange rate movements to one-standard-deviation oil price, supply (productivity) and demand shocks over fifteen years in each country. The use of accumulated responses helps to aid interpretation. The dynamic effect of each

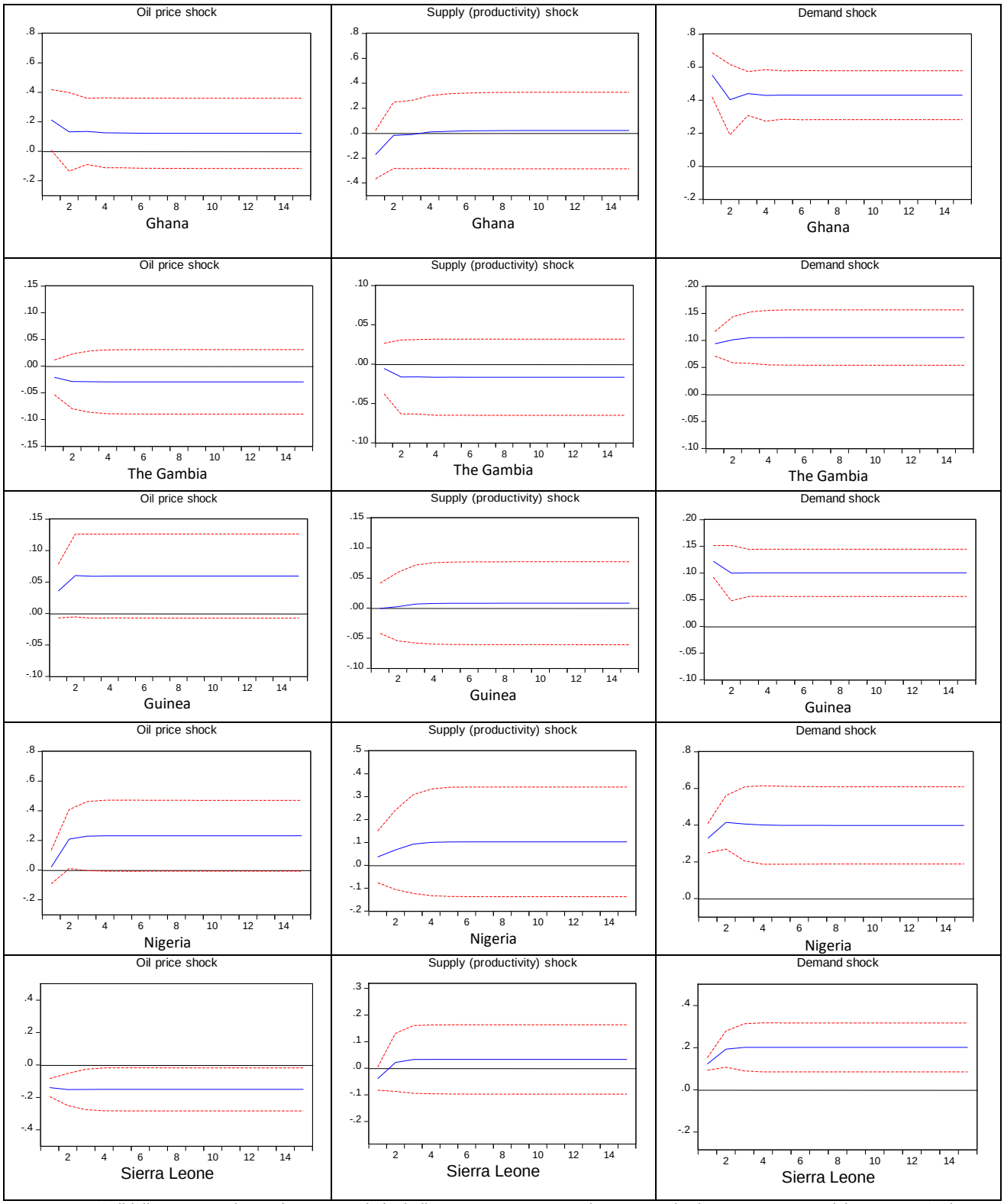
[21] The key assumption for the purposes of estimation and inference is that global variables are weakly exogenous, compatible with a limited degree of weak dependence across idiosyncratic shocks. To satisfy this property, we assume that all economies in the model are small to the world economy, which is reasonable given that our country group consists of developing countries (Dumrongrittikul and Anderson 2016).

structural innovations is reported with a standard deviation band around the point estimate. Recall that the exchange rate is defined, so that an increase in the value of the real exchange rate appreciates the real value of domestic currency. Initial observation of Figure 2 shows that the response of the REER to the three structural shocks differ across countries and the shock is felt immediately in all countries; it peaks about two to three years later. In The Gambia and Sierra Leone, an adverse oil price shock (increase in the real price of oil) depreciates the REER within the first two to three years, after which we observe a permanent depreciation of the REER. In contrast, an increase in the real price of oil permanently appreciates the REER in Guinea, Nigeria, and Ghana. The result is not surprising for Nigeria, being a major oil exporting country.

Furthermore, a supply shock (productivity improvement) permanently tends to lead to an appreciation of the REER in Guinea, Nigeria and Sierra Leone. This corresponds with the traditional Balassa-Samuelson view. In contrast, The Gambia REER depreciates permanently after a supply shock. In Ghana, supply shock has an initial depreciating effect on REER but after that dies out. Though the contrasting findings could reflect the different economic experience and the structure of the WAMZ members, the impact of productivity shock also depends on the transmission mechanism. Thus, whether through the REER is based on tradables prices or through relative prices between tradables and nontradables (Wang et al. 2013). In addition, a demand shock has a permanent appreciating effect on the REER in all countries, though the immediate impact of a one-unit demand shock varies across countries.

Overall, the impulse response analysis indicates that there are notable differences in the results. The response of the REER to oil price, supply (productivity) and demand shocks across the five countries are asymmetric. The indication is that response to the common monetary policy after a shock would vary across the WAMZ countries; hence, the costs of WAMZ members losing monetary autonomy will be much larger in a world where a monetary response to a shock is immediate.

Figure 2 Cumulated impulse responses of real effective exchange rates to one standard deviation structural innovations.



Notes: Solid lines are point estimates, and dash lines represent approximate standard errors, computed by Monte Carlo simulations, using 1000 replications.

3.3.2 Forecast error variance decomposition analysis

The variance decomposition is applied to identify the relative contribution of the three structural shocks on REER fluctuations across the countries. The aim is to investigate whether the sources of variation in the REER are common across the countries. Table 4 reports on the variance decomposition for each of the five sampled country's REER at the 1 and 10-year forecast horizons (Variance decompositions are reported only for the effective real exchange rate). One (10) year responses are taken as short-term (long-term) effects.

The important contributors of the REER are different across economies, shown in Table 4. In the short run, REER fluctuations are driven mostly by country-specific preference demand shocks; explaining over 80 percent of the variability the first year across The Gambia, Ghana, Guinea, and Nigeria. The relative contribution of demand preference shocks declines gradually afterward, but none less than 70 percent. However, the findings are different in Sierra Leone; demand shocks contribute to about 42 and 45 percent of REER fluctuations in the short and long run, respectively. The dominance of domestic demand shocks in REER fluctuations concurs with those found in (Hoffmaister et al. 1998) for non-CFA countries. Also, we find significant differences in the relative importance of supply (productivity) shocks on REER fluctuations. In the short run, supply shock contribution is less than 8% across the five countries; and is almost irrelevant to the REER variability- less than 1 percent- in The Gambia and Guinea. The pattern is almost the same in the long run in the Gambia, Guinea, and Nigeria, where supply shocks explain no more than 3 percent of REER variability. In Ghana and Sierra Leone, the contribution of supply shock to REER movements rises to 13 and 12 percent in the long run, respectively.

Furthermore, the relative importance of oil price (external) shock to REER dynamics is 54, 12, 8, 5 and 3 percent in Sierra Leone, Ghana, Guinea, Gambia, and Nigeria in the short run, respectively. In the long run, the pattern is almost the same in Ghana and The Gambia; marginally rises to 11 percent in Guinea; substantially rises to 20 percent in Nigeria; and declines to 44 percent in Sierra Leone. The result is not surprising, especially for Nigeria, because of the country's heavy dependence on exports of crude oil; whereas the other countries are oil importing countries, exposing these countries to trade and exchange rate fluctuations. Hoffmaister et al. (1998) on the other hand, reported the absence of

the role of external shocks in explaining real exchange rate movements in the non-CFA countries; though the authors used world interest rate and terms of trade shocks as a proxy for external shocks.

Overall, the sources of REER variability are idiosyncratic, and they vary significantly across countries. Table A6 in the appendix also shows similar asymmetric shocks across WAMZ after we replaced oil price shock with terms of trade shock as a common external shock to these countries. The structure and the different economic experience of these economies could contribute to the contrasting importance of the structural shocks on the REER. This result somewhat reinforces the early findings that structural shocks are more asymmetric among WAMZ countries. Therefore, these countries will find it difficult to adjust to either common external, supply or demand shocks if they form a monetary union.

Table 4: Variance decomposition

Horizon	Demand shock	Supply shock	Oil price shock	Demand shock	Supply shock	Oil price shock
	(%)	(%)	(%)	(%)	(%)	(%)
Ghana				Gambia		
1	80.25	7.84	11.91	94.91	0.33	4.76
2	75.60	12.43	11.98	93.20	1.53	5.27
3	75.66	12.40	11.94	93.21	1.52	5.27
4	75.58	12.48	11.94	93.20	1.53	5.27
5	75.57	12.49	11.94	93.20	1.53	5.27
10	75.57	12.49	11.94	93.20	1.53	5.27
Guinea				Nigeria		
1	92.11	0.01	7.89	95.00	2.33	2.67
2	89.03	0.05	10.93	78.44	2.03	19.52
3	88.93	0.15	10.92	77.90	2.39	19.72
4	88.92	0.16	10.92	77.86	2.42	19.72
5	88.92	0.16	10.92	77.86	2.42	19.72
10	88.92	0.16	10.92	77.86	2.42	19.72
Sierra Leone						
1	41.74	4.25	54.01			
2	44.61	11.71	43.69			
3	44.57	11.93	43.50			
4	44.57	11.93	43.50			
5	44.57	11.93	43.50			
10	44.57	11.93	43.50			

4 Conclusion and Policy Recommendations

One basic precondition that determines the ability to conduct monetary policy smoothly in a monetary union is the symmetry of response to common policy across different countries. In this paper, we focus on one of the main issues in the debate of monetary union in the West African Monetary Zone (WAMZ), whether shocks that cause macroeconomic fluctuations are symmetric or not across these countries. Consequently, we assess the behaviour of real effective exchange rates (REER) across these countries to characterise macroeconomic asymmetry. The analysis is conducted twofold:

First, we estimate the short-run and long-run effects of macroeconomic fundamentals on REERs to assess the behaviour of real effective exchange rates (REER) across these countries using country-by-country VECM. We further derive the equilibrium REER and misalignments for these countries to examine whether they are converging over time towards the equilibrium. Overall, productivity differentials, terms of trade, real oil price, government consumption and trade openness are found to be important determinants of REER in the long run in WAMZ. However, the significant impact of the common fundamentals on REER are different across economies. Also, the country-specific VECM results show the existence of REER mean reversion in 3 countries, but the speed of adjustment varies across candidate countries. Furthermore, the computed REER misalignments suggest that before 2007 the REER of WAMZ members experienced high divergence from equilibrium path. The degree of REER misalignments appears to diminish, converging towards equilibrium between 2007-2015.

Second, we identify three types of shocks- oil price, productivity (supply) and demand preference shocks- from exchange rate determinants using the structural autoregressive model (SVAR) and assess how REERs respond to these shocks to characterise asymmetry across WAMZ. From the impulse response analysis, there appear to be marked differences in the effects of oil price (external) shock among the WAMZ countries REER. Whereas real oil price shock lead to a permanent real appreciation in Nigeria, Guinea and Ghana, the contrary is observed in The Gambia and Sierra Leone. The response of REER to supply (productivity) shock across the five countries are also asymmetric. Though the response of REER to domestic aggregate demand shocks are positive for all countries, they differ in size and speed, indicating idiosyncratic aggregate demand shock. In the case

of the variance decomposition, the sources of REER variability are idiosyncratic, and they vary significantly across countries.

The overall evidence from the empirical investigation points to heterogeneous economies. The structure and the different economic experience of these economies could contribute to the structural differences. Our findings imply that, in the absence of an alternative adjustment mechanism (such as fiscal transfer schemes), a move towards monetary union will be associated with significant cost to the countries in a world where a monetary response to a shock is immediate. Idiosyncratic shocks imply the need for different policy responses to adjust to macroeconomic shocks. This strengthens the case for policy autonomy in the region and is consistent with previous studies showing considerable economic divergences amongst WAMZ countries as the main constraint to monetary union.

Notwithstanding, there is a case for monetary union, but it is indispensable that authorities appreciate the potential asymmetries from common policies and shocks. Furthermore, we argue that to avoid asymmetric responses from policy changes; (1) structural transformations and economic diversifications are critical. This requires scaling up toward activities with higher technology (at least small-scale manufacturing), which can transform the raw materials and primary commodities efficiently into manufactured goods would yield significant dividends regionally (Rodrik 2007; Stiglitz and Greenwald 2014; Guzman et al. 2018). This concurs with (Kenen 1969) that the more diversified an economy is, the less vulnerable it is to sector specific shocks and the smaller is the stabilization cost of joining a monetary union (2) Member countries ought to increase both political and economic commitments towards the project and by incorporating regional integration objectives into national development programmes. By so doing, there will be a harmonized development policy aimed at fostering greater compatibility and subsequently achieve convergence between national and regional plans.

The analysis of shock asymmetry still provides springboards for future research; for example, assessing the possibility of increased business cycle correlation synchronisation with a common currency through increased trade among the countries (Frankel and Rose 1998).

Appendix

Table A1. Trade Weight Used in Construction of REER and Fundamentals

Country	**Main trade partners**					Total
Ghana	EU (Germany)	China	S/A	US	UK	
A	28.30%	11.58%	10.74%	5.98%	3.87%	60.74
B	0.47	0.20	0.18	0.10	0.06	1
Nigeria	US	China	India	EU (Germany)	UK	
A	14.06%	10.42%	8.50%	13.89%	4.08%	50.95%
B	0.28	0.2	0.17	0.27	0.08	1
Gambia	China	CFA (Senegal)	EU (Germany)	UK	India	
A	25.40%	19.17%	5.32%	2.30%	10.75%	62.94
B	0.4	0.3	0.08	0.04	0.17	1
Liberia	South Korea	China	EU (Germany)	US	Japan	
A	25.65%	15.63%	20.26%	7.91%	3.28%	72.73%
B	0.35	0.21	0.28	0.11	0.05	1
Guinea	EU (Germany)	China	India	US	Chile	
A	26.99%	11.31%	11.50%	4.76%	6.30%	60.86%
B	0.44	0.19	0.19	0.08	0.10	1
Sierra Leone	China	EU (Germany)	UK	US	S/A	
A	28.32%	19.52%	5.32%	4.81%	3.53%	61.50
B	0.46	0.32	0.09	0.08	0.06	1

Source: Author's (2017). A: Trade weight (% of total trade) B: Normalized Trade weight

The following procedure was followed in the construction of REER indexes:

1. The trade weights (w_i) were constructed using Zanello and Desruelle (1997) methodology and data gathered from the International Monetary Fund Directions of Trade (DOTs). The computed weights are in table 1.
2. The trading partners chosen were the 5 major trading countries whose trade level accounted for over 50% out of total trade averaged for the period 2010-2014.
3. In all cases the NEER between these countries and their trading partners were obtained from IMF IFS; CPI for trading partners were obtained from IFS and WDI. The CPI and NEER are all re-based so that they all equal 100 in 2000.

Table A2 Time Series Unit Root Testing

		ADF				PP				
Country	**Variables**	**Level**		**First Difference**		**Level**		**First Difference**		**Decision**
		Constant	***Constant & trend***	***Constant***	***Constant & trend***	***Constant***	***Constant & trend***	***Constant***	***Constant & trend***	
Ghana	**Lreer**	-1.553	-1.866	-6.125***	-6.259***	-1.374	-1.870	-6.124***	-6.626***	$I(1)$
	Ltot	-2.0774	-2.464	-7.292***	-6.065***	-2.060	-2.440	-7.273***	-8.511***	$I(1)$
	Lpro	1.652	-2.904	-3.432**	-4.035**	1.652	-2.305	-3.544**	-4.126**	$I(1)$
	loil	-1.189	-1.831	-5.404***	-5.398***	-1.243	-1.831	-5.319***	-5.334***	$I(1)$
	Lgov	-1.288	-2.915	-4.886***	-4.810***	-1.382	-3.195	-8.045***	-8.250***	$I(1)$
	rir	-4.008***	-5.275***	-	-	-3.992***	-5.400***	-	-	$I(0)$
	Lopen	-2.921	-2.808	-6.097***	-7.634***	-1.397	-1.679	-4.814***	-5.036***	$I(1)$
The Gambia	**Lreer**	-0.271	-2.463	-5.121***	-5.085***	-0.217	-2.224	-5.122***	-5.087***	$I(1)$
	Ltot	-2.430	-2.848	-6.242***	-6.156***	-2.472	-2.310	-6.320***	-6.212***	$I(1)$
	Lpro	-0.973	-2.526	-7.615***	-8.193***	-0.884	-2.515	-7.801***	-7.629***	$I(1)$
	loil	-0.867	-2.318	-5.453***	-5.353***	-0.860	-2.318	-5.430***	-5.302***	$I(1)$
	Lgov	-1.904	-2.235	-7.941***	-8.135***	-1.728	-2.483	-8.709***	-9.968***	$I(1)$
	rir	-4.464***	-5.558***	-	-	-4.492***	-5.596***	-	-	$I(0)$
	Lopen	-1.839	-1.920	-7.039***	-7.034***	-1.756	-1.826	-7.056***	-7.058***	$I(1)$
Nigeria	**Lreer**	-1.931	-1.771	-4.403***	-4.416***	-2.087	-1.771	-4.312***	-4.243**	$I(1)$
	Ltot	-1.668	-2.018	-4.451***	-4.544***	-1.709	-1.921	-5.271***	-5.309***	$I(1)$
	Lpro	-1.962	-2.716	-4.729***	-5.348***	-2.084	-2.684	-4.721***	-5.354***	$I(1)$
	loil	-0.508	-2.911	-6.374***	-6.236***	-0.465	-2.820	-6.392***	-6.244***	$I(1)$
	Lgov	-2.593	-2.622	-6.540***	-6.460***	-2.588	-2.644	-6.574***	-6.494***	$I(1)$
	rir	-5.724***	-6.533***	-	-	-5.724***	-7.278***	-	-	$I(0)$
	Lopen	-1.922	-1.803	-7.574***	-7.561***	-1.936	-1.821	-7.529***	-7.526***	$I(1)$
Sierra Leone	**Lreer**	-1.408	-1.180	-4.490***	-4.563***	-1.545	-1.558	-4.473***	-4.497***	$I(1)$
	Ltot	-0.652	-2.025	-4.884***	-4.787***	-0.677	-2.029	-4.882***	-4.728***	$I(1)$
	Lpro	-1.795	-1.222	-5.070***	-5.378***	-1.791	-1.106	-5.070***	-5.097***	$I(1)$
	loil	-1.885	0.087	-4.540***	-5.152***	-1.795	-0.056	-4.658***	-5.152***	$I(1)$
	Lgov	-2.733	-3.081	-9.567***	-9.433***	-2.650	-3.499	-9.740***	-9.623***	$I(1)$
	rir	-3.375**	-4.687***	-	-	-3.323**	-4.662***	-	-	$I(0)$
	Lopen	-2.639	-3.117	-7.120***	-7.108***	-2.767	-3.150	-7.070***	-7.071***	$I(1)$
Guinea	**Lreer**	-1.867	-1.999	-5.694***	-5.738***	-1.830	-2.075	-5.720***	-5.825***	$I(1)$
	Ltot	-2.046	-2.270	-6.081***	-5.990***	-1.952	-2.231	-6.157***	-6.047***	$I(1)$
	Lpro	-0.811	-1.911	-3.779***	-3.701**	-0.786	-1.650	-3.740***	-3.660**	$I(1)$
	loil	-0.850	-1.736	-4.721***	-4.626***	-0.853	-1.912	-4.713***	-4.617***	$I(1)$
	Lgov	-1.120	-0.913	-4.198***	-4.354***	-1.382	-1.166	-4.084***	-4.353***	$I(1)$
	rir	-	-	-	-	-	-	-	-	-
	Lopen	-1.672	-2.290	-6.364***	-6.339***	-1.592	-2.220	-6.571***	-6.600***	$I(1)$

Note:*** and **denotes statistical significance at the 1% and 5% level to reject the unit root null hypothesis, respectively.

Table A3. Perron (1997) unit root test with structural break REER

	Levels		First difference		Decision
Country	t-stat	Year Break	t-stat	Year Break	
Ghana	-3.954 (1)	1986	-6.436*** (0)	1988	$\boldsymbol{I(1)}$
Gambia	-4.203 (0)	2001	-6.249*** (0)	2003	$\boldsymbol{I(1)}$
Nigeria	-4.014 (1)	1986	-5.287*** (0)	1987	$\boldsymbol{I(1)}$
Sierra Leone	-4.803*** (0)	1986	-	-	$\boldsymbol{I(0)}$
Guinea	-3.926 (0)	1985	-6.624*** (0)	1986	$\boldsymbol{I(1)}$

Notes: The numbers in parentheses are the lag order. The lag parameters are selected based on the AIC. Null Hypothesis: LREER has a unit root with a structural break in the intercept. *** and **denotes statistical significance at the 1% and 5% level to reject the unit root null hypothesis, respectively

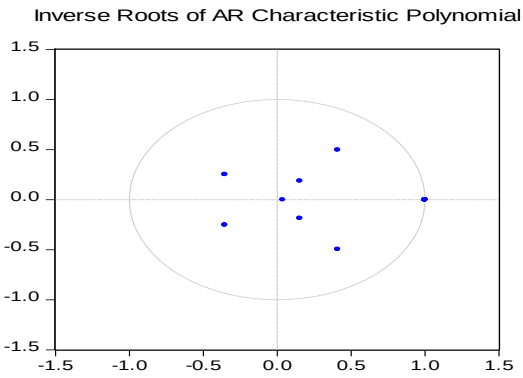
Table A4. LR statistics for testing weak exogeneity of the foreign and external (oil price) variables

		Ghana	Gambia	Nigeria	Sierra Leone	Guinea
D(lpro)	χ^2 (1)	8.494	8.514	0.065	10.143	1.320
	p-value	0.003	0.003	0.798	0.001	0.250
D(ltot)	χ^2 (1)	0.328	3.221	0.898	0.006	1.710
	p-value	0.566	0.072	0.343	0.935	0.190
D(loil)	χ^2 (1)	7.449	3.633	1.206	0.008	2.854
	p-value	0.006	0.056	0.271	0.926	0.091
D(lopen)	χ^2 (1)	0.002	0.145	0.467	0.048	-
	p-value	0.966	0.702	0.494	0.826	-
D(lgov)	χ^2 (1)	0.487	3.422	1.219	1.997	1.230
	p-value	0.485	0.064	0.269	0.157	0.267

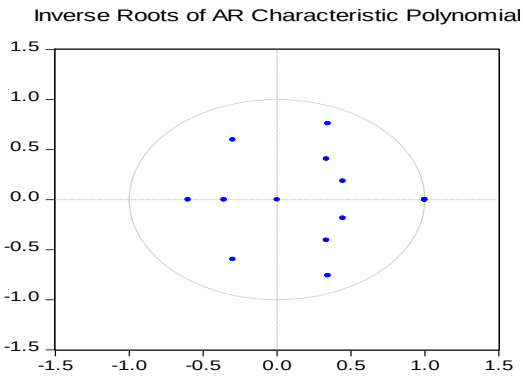
Notes: The weak exogeneity test is performed by imposing zero restrictions on the $\boldsymbol{\alpha_i}$ matrix in the error correction equations.

Table A5. VECM Diagnostic Tests

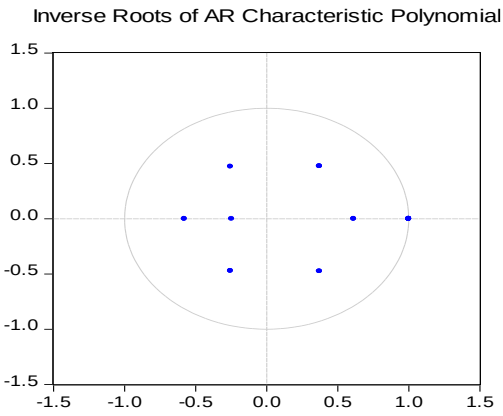
Ghana



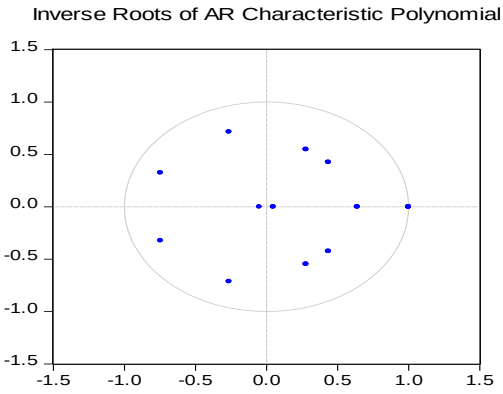
Nigeria



The Gambia



Sierra Leone



Guinea

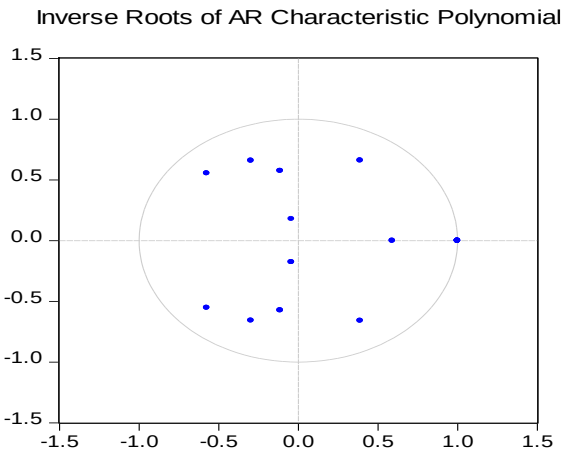


Table A6. Variance decomposition

Horizon	**Demand Shock**	**Supply shock**	**Terms of trade shock**	**Demand Shock**	**Supply shock**	**Terms of trade shock**
	(%)	(%)	(%)	(%)	(%)	(%)
Ghana				The Gambia		
1	81.56	13.02	5.42	98.71	1.01	0.28
2	76.50	15.59	7.91	94.91	1.17	3.92
3	76.34	15.72	7.94	94.03	1.38	4.60
4	76.20	15.79	8.01	93.78	1.44	4.78
5	76.18	15.81	8.01	93.71	1.46	4.83
6	76.18	15.81	8.01	93.70	1.47	4.84
10	76.17	15.82	8.01	93.69	1.47	4.84
Guinea				Nigeria		
1	86.00	0.30	13.70	81.77	5.35	12.88
2	84.62	0.81	14.57	79.69	6.54	13.77
3	83.72	1.87	14.41	79.76	6.52	13.72
4	83.72	1.88	14.41	79.76	6.52	13.72
5	83.72	1.88	14.41	79.76	6.52	13.72
6	83.72	1.88	14.41	79.76	6.52	13.72
10	83.72	1.88	14.41	79.76	6.52	13.72
Sierra Leone						
1	99.14	0.53	0.33			
2	92.48	4.47	3.05			
3	92.19	4.74	3.07			
4	92.15	4.77	3.08			
5	92.15	4.77	3.08			
6	92.15	4.77	3.08			
10	92.15	4.77	3.08			

References

Adepoju, A. (2005) Migration in West Africa. A paper prepared for the Policy Analysis and Research Program of the Global Commission on International Migration. *Human Resources Development Centre Lagos, Nigeria* Paper No. RS8.

Alagidede, P., Tweneboah, G. and Adam, A. M. (2008) Nominal Exchange Rates and Price Convergence in the West African Monetary Zone. *International Journal of Business and Economics* 7 (3), 181-198.

Alesina, A. and Barro, R. J. (2002) Currency unions. *The Quarterly Journal of Economics* 117 (2), 409-436.

Alexius, A. and Post, E. (2008) Exchange rates and asymmetric shocks in small open economies. *Empirical Economics* 35 (3), 527-541.

Asongu, S. (2014) REER imbalances and macroeconomic adjustments in the proposed West African Monetary Union. *South African Journal of Economics* 82 (2), 276-289.

Baffes, J., Elbadawi, I. and O'Connel, S. (1999) Single-Equation Estimation of the Equilibrium Real Exchange Rate. In Hinkle, L. E. and Montiel, P. J. (editors) *Exchange Rate Misalignment: Concepts and Measurement for Developing Countries.* New York: Oxford University Press.

Balassa, B. (1964) The Purchasing-Power Parity Doctrine: A Reappraisal. *The Journal of Political Economy* 72 (6), 584-596.

Balázs, É. and Amina, L.-R. (2003) Estimating the equilibrium exchange rate of the Central and Eastern European acceding countries: The challenge of euro adoption. *Review of World Economics* 139 (4), 683-708.

Ballabriga, F., Sebastian, M. and Vallés, J. (1999) European asymmetries. *Journal of International Economics* 48 (2), 233-253.

Bayoumi, T. and Eichengreen, B. (1992) *Shocking aspects of European monetary unification.* National Bureau of Economic Research.

Beetsma, R. and Giuliodori, M. (2010) The macroeconomic costs and benefits of the EMU and other monetary unions: an overview of recent research. *Journal of Economic literature* 48 (3), 603-41.

Beirne, J. (2010) *International Exchange Rate Dynamics and Purchasing Power Parity*. PhD. Brunel University.

Blanchard, O. J. and Quah, D. (1989) The Dynamic Effects of Aggregate Demand and Supply Disturbances. *The American Economic Review* 79 (4), 655-673.

Boamah, M. I. (2009) *The Monetary Policy Transmission Mechanism and Inflation Control in Ghana*. PhD Thesis. Nottingham Trent University.

Buigut, S. K. and Valev, N. T. (2005) Is the proposed East African monetary union an optimal currency area? A structural vector autoregression analysis. *World Development* 33 (12), 2119-2133.

Buiter, W. H. (1997) The economic case for monetary union in the European Union. *Review of International Economics* 5, 10-35.

Buiter, W. H. (2000) Optimal currency areas scottish economic society/royal bank of scotland annual lecture, 1999. *Scottish Journal of Political Economy* 47 (3), 213-250.

Carrière-Swallow, Y. and Céspedes, L. F. (2013) The impact of uncertainty shocks in emerging economies. *Journal of International Economics* 90 (2), 316-325.

Chen, C., Yao, S. and Ou, J. (2017) Exchange rate dynamics in a Taylor rule framework. *Journal of International Financial Markets, Institutions and Money* 46, 158-173.

Chen, S.-S. and Chen, H.-C. (2007) Oil prices and real exchange rates. *Energy Economics* 29 (3), 390-404.

Cheung, Y. W. and Lai, K. S. (1993) Finite-sample sizes of Johansen's likelihood ratio tests for cointegration. *Oxford Bulletin of Economics and statistics* 55 (3), 313-328.

Chowdhury, K. (2012) Modelling the dynamics, structural breaks and the determinants of the real exchange rate of Australia. *Journal of International Financial Markets, Institutions and Money* 22 (2), 343-358.

Chudik, A. and Mongardini, J. (2007) In search of equilibrium: estimating equilibrium real exchange rates in Sub-Saharan African countries. *IMF Working Papers*, 1-39.

Clark, P. B. and MacDonald, R. (1998) Exchange rates and economic fundamentals: A methodological comparison of BEERs and FEERs. *IMF Working Paper (98/67)*.

Clark, P. B. and MacDonald, R. (1999) Exchange rates and economic fundamentals: a methodological comparison of BEERs and FEERs. In R, M. and J.L., S. (editors) *Equilibrium exchange rates. Recent Economic Thought Series.* Vol. 69. Dordrecht: Springer. 285-322.

Clerc, L., Dellas, H. and Loisel, O. (2011) To be or not to be in monetary union: A synthesis. *Journal of International Economics* 83 (2), 154-167.

Coudert, V. and Couharde, C. (2003) Exchange Rate Regimes and Sustainable Parities for CEECs in the Run-up to EMU Membership. *Revue économique* 54 (5), 983-1012.

Couharde, C., Coulibaly, I. and Damette, O. (2013) Anchor currency and real exchange rate dynamics in the CFA Franc zone. *Economic Modelling* 33, 722-732.

Coulibaly, I. and Gnimassoun, B. (2013) Optimality of a monetary union: new evidence from exchange rate misalignments in West Africa. *Economic Modelling* 32, 463-482.

Craighead, W. D. and Tien, P.-L. (2015) Nominal shocks and real exchange rates: Evidence from two centuries. *Journal of International Money and Finance* 56, 135-157.

De Grauwe, P. (1996) The economics of convergence: Towards monetary union in Europe. *Weltwirtschaftliches Archiv* 132 (1), 1-27.

De Grauwe, P. (2000) Monetary policies in the presence of asymmetries. *Journal of Common Market Studies* 38 (4), 593-612.

De Grauwe, P. and Mongelli, F. P. (2005) Endogeneities of optimum currency areas: What brings countries sharing a single currency closer together?

Debrun, X., Masson, P. and Pattillo, C. (2005) Monetary union in West Africa: who might gain, who might lose, and why? *Canadian Journal of Economics/Revue canadienne d'économique* 38 (2), 454-481.

Dufrénot, G., Lardic, S., Mathieu, L., Mignon, V. and Péguin-Feissolle, A. (2008) Explaining the European exchange rates deviations: Long memory or non-linear adjustment? *Journal of International Financial Markets, Institutions and Money* 18 (3), 207-215.

Dumrongrittikul, T. and Anderson, H. M. (2016) How do shocks to domestic factors affect real exchange rates of Asian developing countries? *Journal of Development Economics* 119 (Supplement C), 67-85.

Edwards, S. (1988a) *Exchange rate misalignment in developing countries.* Vol. 2. Baltimore: Johns Hopkins University Press.

Edwards, S. (1988b) Real and monetary determinants of real exchange rate behavior: Theory and evidence from developing countries. *Journal of development economics* 29 (3), 311-341.

Edwards, S. (1989) *Real exchange rates, devaluation, and adjustment: exchange rate policy in developing countries.* MIT press Cambridge, MA.

Égert, B., Halpern, L. and MacDonald, R. (2006) Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues. *Journal of Economic Surveys* 20 (2), 257-324.

Ekpo, A. H. and Udoh, E. (2014) Policy Coordination Framework for the Proposed Monetary Union in ECOWAS. *Regional Economic Integration in West Africa.* Springer. 59-77.

Elbadawi, I. (1994) Estimating long-run equilibrium real exchange rates. In Williamson, J. (editor) *Estimating equilibrium exchange rates.* Washington, D.C.: Institute for International Economics.

Elbadawi, I. and Soto, R. (2005) Theory and Empirics of Real Exchange Rates in Sub-Saharan Africa and Other Developing Countries. *World Bank mimeo*.

Enders, W. (2008) *Applied econometric time series.* John Wiley & Sons.

Enders, W. and Hum, S. (1994) Theory and Tests of Generalized Purchasing-Power Parity: Common Trends and Real Exchange Rates In the Pacific Rim. *Review of International Economics* 2 (2), 179-190.

Engle, R. F. and Granger, C. W. (1987) Co-integration and error correction: representation, estimation, and testing. *Econometrica* 55 (2), 251-276.

Fielding, D. and Shields, K. (2005) The impact of monetary union on macroeconomic integration: evidence from West Africa. *Economica* 72 (288), 683-704.

Forbes, K. J., Hjortsoe, I. and Nenova, T. (2015) The shocks matter: improving our estimates of exchange rate pass-through. *Journal of International Economics* 114, 255-275.

Fosu, A. K. (2001) Emerging Africa: the case of Ghana. *Africa Economic Research Consortium: Nairobi*.

Frankel, J. A. and Rose, A. K. (1998) The Endogeneity of the Optimum Currency Area Criteria. *The Economic Journal* 108 (449), 1009-1025.

Gervais, O., Schembri, L. and Suchanek, L. (2016) Current account dynamics, real exchange rate adjustment, and the exchange rate regime in emerging-market economies. *Journal of Development Economics* 119, 86-99.

Gulde, M. A. M. and Tsangarides, M. C. G. (2008) *The CFA franc zone: common currency, uncommon challenges.* International Monetary Fund.

Guzman, M., Ocampo, J. A. and Stiglitz, J. E. (2018) Real exchange rate policies for economic development. *World Development* 110, 51-62.

Harris, R. I. (1995) *Using cointegration analysis in econometric modelling.* London: Prentice Hall.

Harvey, S. K. and Cushing, M. J. (2015) Is West African Monetary Zone (WAMZ) a common currency area? *Review of Development Finance* 5 (1), 53-63.

Hatemi-J, A. (2002) Fiscal policy in Sweden: effects of EMU criteria convergence. *Economic Modelling* 19 (1), 121-136.

Hendry, D. F. (1995) *Dynamic econometrics.* Oxford University.

Hinkle, L. E. and Montiel, P. J. (1999) *Exchange rate misalignment: concepts and measurement for developing countries.* New York: Oxford University Press.

Hoffmaister, A. W., Roldós, J. E. and Wickham, P. (1998) Macroeconomic fluctuations in sub-Saharan Africa. *Staff Papers* 45 (1), 132-160.

Houssa, R. (2008) Monetary union in West Africa and asymmetric shocks: A dynamic structural factor model approach. *Journal of Development Economics* 85 (1), 319-347.

Hsiao, C. (2014) *Analysis of panel data.* 3 edition. New York: Cambridge university press.

Iimi, A. (2006) Exchange rate misalignment: an application of the behavioral equilibrium exchange rate (BEER) to Botswana. *International Monetary Fund, WP/06/140*.

Isard, P. and Faruqee, H. (1998) *Exchange rate assessment: extension of the macroeconomic balance approach.* Vol. 167. International monetary fund.

Johansen, S. (1988) Statistical analysis of cointegration vectors. *Journal of economic dynamics and control* 12 (2-3), 231-254.

Johansen, S. (1991) Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society*, 1551-1580.

Johansen, S. (1992) Determination of Cointegration Rank in the Presence of a Linear Trend. *Oxford Bulletin of Economics and Statistics* 54 (3), 383.

Johansen, S. (1995) Identifying restrictions of linear equations with applications to simultaneous equations and cointegration. *Journal of econometrics* 69 (1), 111-132.

Kamar, B. and Ben Naceur, S. (2007) GCC monetary union and the degree of macroeconomic policy coordination. *IMF Working Papers*, 1-33.

Kenen, P. (1969) The Theory of Optimum Currency Areas: An Eclectic View. In Mundell, R. and Swoboda, A. (editors) *Monetary Problems of the International Economy.* Chicago: University of Chicago Press.

Kenen, P. B. and Meade, E. E. (2008) *Regional monetary integration.* Cambridge: Cambridge University Press.

Kia, A. (2013) Determinants of the real exchange rate in a small open economy: Evidence from Canada. *Journal of International Financial Markets, Institutions and Money* 23, 163-178.

Kizys, R. and Pierdzioch, C. (2009) Changes in the international comovement of stock returns and asymmetric macroeconomic shocks. *Journal of International Financial Markets, Institutions and Money* 19 (2), 289-305.

Lane, P. R. (2012) The European sovereign debt crisis. *The Journal of Economic Perspectives* 26 (3), 49-67.

Lumkile, M. (2016) *Explainer: Nigeria's move from a fixed to a floating exchange-rate policy*. theconversation.

Lütkepohl, H. and Krätzig, M. (2004) *Applied time series econometrics.* New York: Cambridge University Press.

MacDonald, R. (1998) What determines real exchange rates?: The long and the short of it. *Journal of International Financial Markets, Institutions and Money* 8 (2), 117-153.

Masson, P. R. (2008) Currency unions in Africa: is the trade effect substantial enough to justify their formation? *The World Economy* 31 (4), 533-547.

Masson, P. R. and Pattillo, C. A. (2005) *The monetary geography of Africa.* Washington, D.C: Brookings Institution Press.

McKinnon, R. I. (1963) Optimum currency areas. *The American Economic Review* 53 (4), 717-725.

Mélitz, J. and Zumer, F. (1999) Interregional and international risk-sharing and lessons for EMU. *Carnegie-Rochester Conference Series on Public Policy.* Vol. 51. Elsevier.

Mundell, R. A. (1961) A theory of optimum currency areas. *The American Economic Review* 51 (4), 657-665.

Mundell, R. A. (1973) Uncommon Arguments for Common Currencies. In Johnson, H. G. and Swoboda, A. K. (editors) *The Economics of Common Currencies.* London Allen & Unwin. pp. 114-132.

Obstfeld, M. and Rogoff, K. (2009) Global imbalances and the financial crisis: products of common causes. In *Asia and the Global Financial Crisis. Asia Economic Policy Conference.* Santa Barbara, CA: October 18-20, 2009. Federal Reserve Bank of San

Francisco.*https://eml.berkeley.edu/~obstfeld/santabarbara.pdf* Accessed: 23 November 2017.

Obstfeld, M. and Rogoff, K. S. (2005) Global current account imbalances and exchange rate adjustments. *Brookings papers on economic activity* 2005 (1), 67-146.

Obstfeld, M., Rogoff, K. S. and Wren-lewis, S. (1996) *Foundations of international macroeconomics.* Cambridge, MA: MIT Press.

Opoku-Afari, M., Morissey, O. and Lloyd, T. (2004) *Real exchange rate response to capital inflows: A dynamic analysis for Ghana*. Nottingham, CREDIT Research Paper.

Oshikoya, T. W. (2010) *Monetary and financial integration in West Africa.* Routledge.

Pisani-Ferry, J. (2013) The known unknowns and unknown unknowns of European Monetary Union. *Journal of International Money and Finance* 34, 6-14.

Ricci, L. A., Milesi-Ferretti, G. and Lee, J. (2013) Real Exchange Rates and Fundamentals: A Cross-Country Perspective. *Journal of Money, Credit and Banking* 45 (5), 845-865.

Rodrik, D. (2007) *One economics, many recipes: globalization, institutions, and economic growth.* Princeton: Princeton University Press.

Rogers, J. H. (1999) Monetary shocks and real exchange rates. *Journal of International Economics* 49 (2), 269-288.

Rubio, M. and Comunale, M. (2017) Lithuania in the euro area: monetary transmission and macroprudential policies. *Eastern European Economics* 55 (1), 29-49.

Samuelson, P. A. (1964) Theoretical Notes on Trade Problems. *The review of economics and statistics* 46 (2), 145-154.

Stiglitz, J. E. and Greenwald, B. C. (2014) *Creating a learning society: A new approach to growth, development, and social progress.* Columbia University Press.

Tapsoba, S. J. (2011) West African monetary integration and interstates risk-sharing.

Tavlas, G. S. (1993) The 'new' theory of optimum currency areas. *The world economy* 16 (6), 663-685.

Tavlas, G. S. (2009) Optimum-Currency-Area Paradoxes. *Review of International Economics* 17 (3), 536-551.

Tsangarides, C. G. and Qureshi, M. S. (2008) Monetary union membership in West Africa: A cluster analysis. *World Development* 36 (7), 1261-1279.

Tsen, W. H. (2011) The real exchange rate determination: An empirical investigation. *International Review of Economics & Finance* 20 (4), 800-811.

Volz, U. (2010) *Prospects for monetary cooperation and integration in East Asia.* London, England: MIT Press.

Von Hagen, J. and Neumann, M. J. (1994) Real exchange rates within and between currency areas: How far away is EMU? *The Review of Economics and Statistics*, 236-244.

Wang, C.-H., Lu, Y.-H., Huang, C.-W. and Lee, J.-Y. (2013) R&D, productivity, and market value: An empirical study from high-technology firms. *Omega* 41 (1), 143-155.

WorldBank (1986) *Guinea - Structural Adjustment Program Project.* Washington, DC: World Bank. *http://documents.worldbank.org/curated/en/100511468033666169/Guinea-Structural-Adjustment-Program-Project* Accessed 20 November 2017.

Zhao, X. and Kim, Y. (2009) Is the CFA Franc zone an optimum currency area? *World Development* 37 (12), 1877-1886.

Zhou, S. (1995) The response of real exchange rates to various economic shocks. *Southern Economic Journal*, 936-954.